United States Patent [19]

Brown

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[54] **SLACK TAKEUP APPARATUS FOR AN ENDLESS EXCAVATING MEMBER**

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[73] Assignee: **Roscoe Brown Corporation**, Lenox, Iowa

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[51] **Int. Cl.**[2] **E02F 5/08**

[52] **U.S. Cl.** **37/97**; 37/189

[58] **Field of Search** ..... 37/91, 94–97, 37/189, 190, 191 R, 191 A, 192 R, 192 A, 108 R, 83–90

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Attorney, Agent, or Firm—Zarley, McKee, Thomte, Voorhees & Sease

[57] **ABSTRACT**

A slack takeup apparatus for a circular excavating rim includes a support frame and first and second rim engaging wheels mounted on the support frame in spaced-apart relation for rotation about stationary axes. A third rim engaging wheel is rotatably mounted at the free end of a pivot member connected to the support frame. An extensible power member is pivotally connected to and extended between the third wheel and support frame for pivotally moving the third wheel and pivot arm to take up slack between the wheels and circular rim.

5 Claims, 9 Drawing Figures

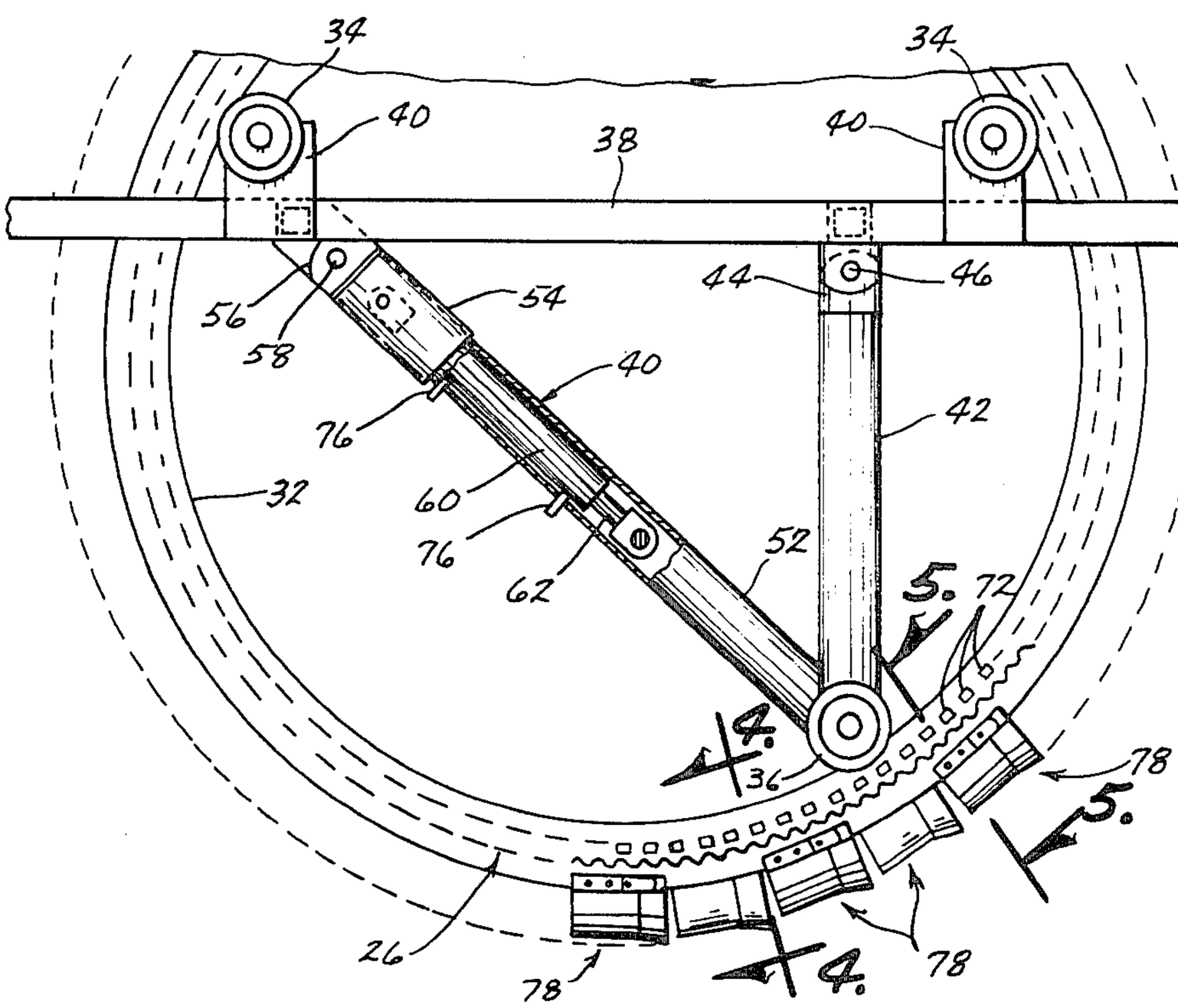

Fig. 5.

Fig. 4.

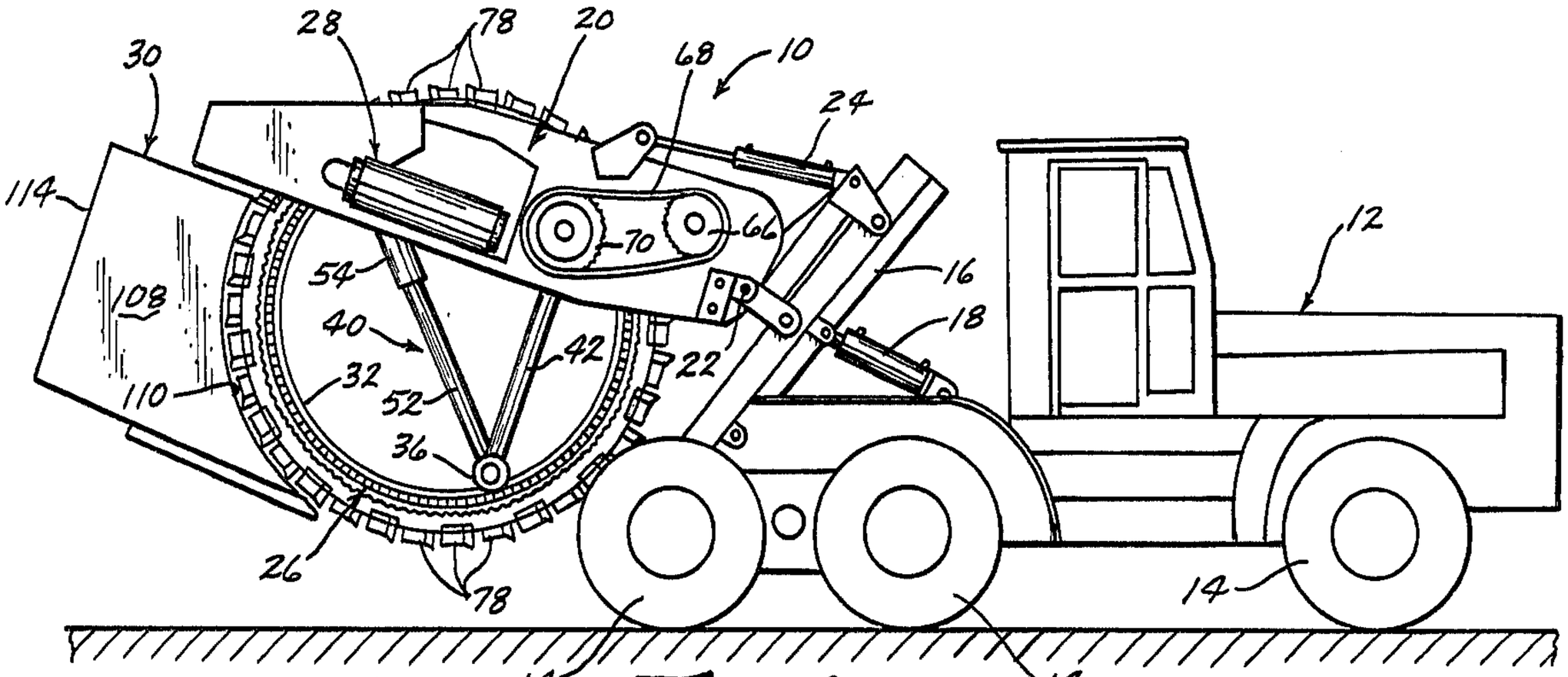

Fig. 1

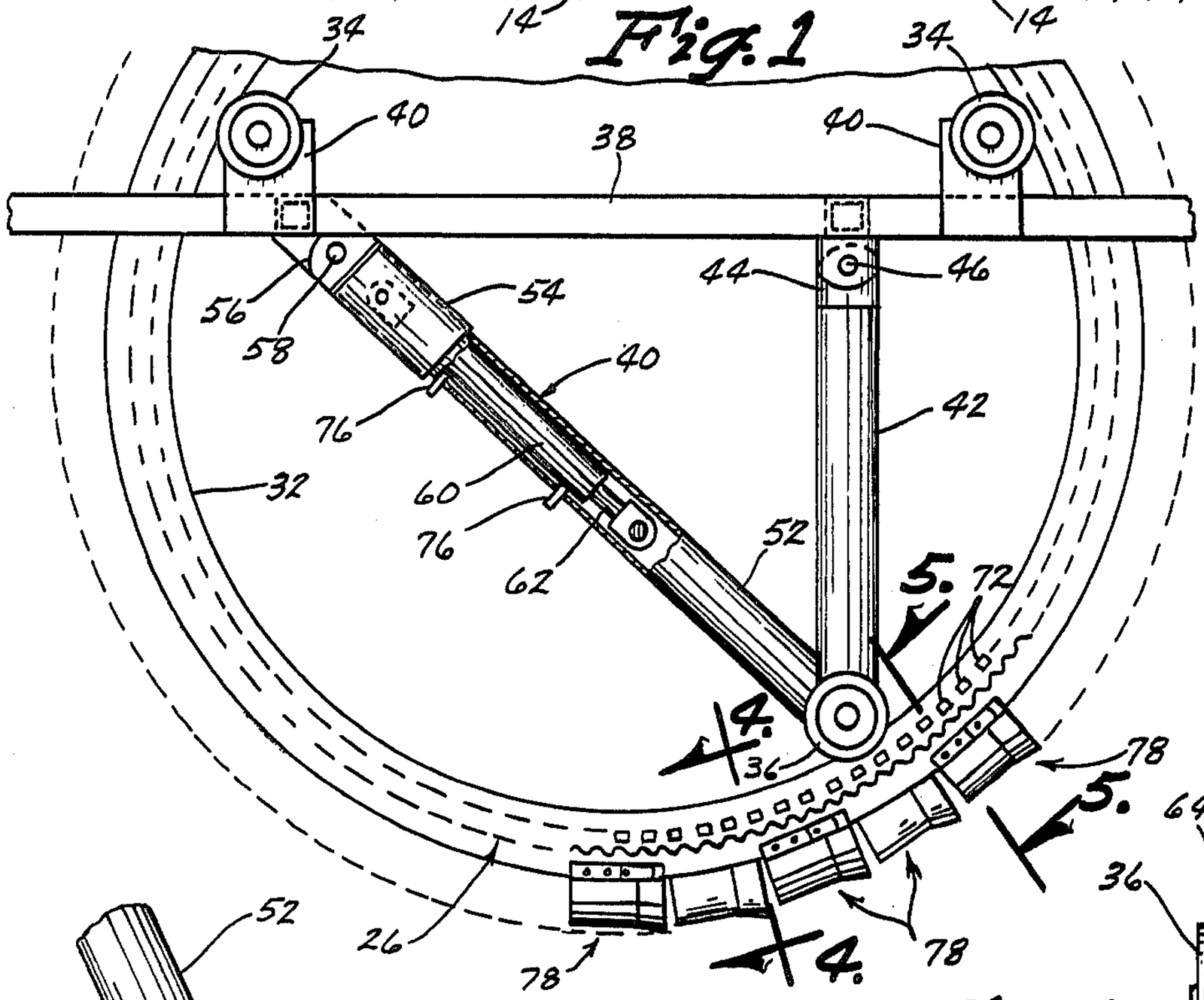

Fig. 2

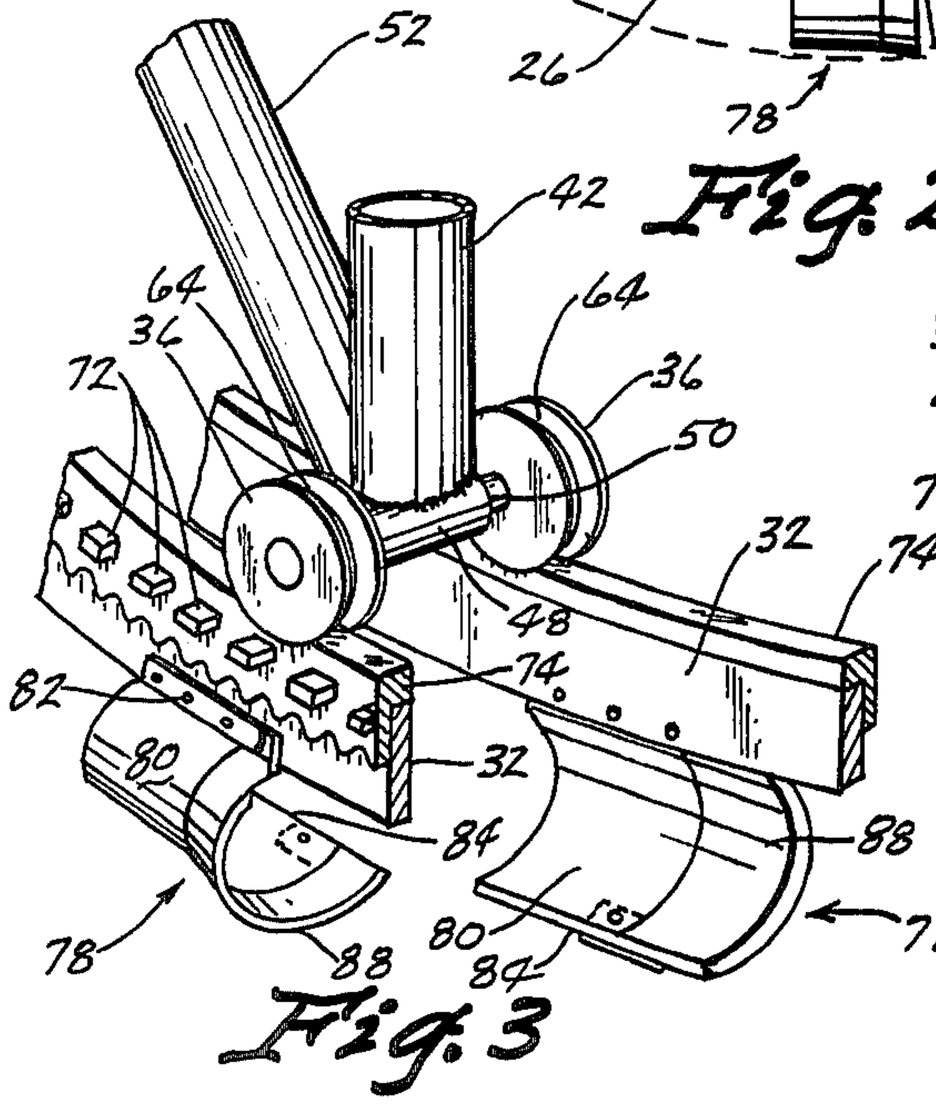

Fig. 3

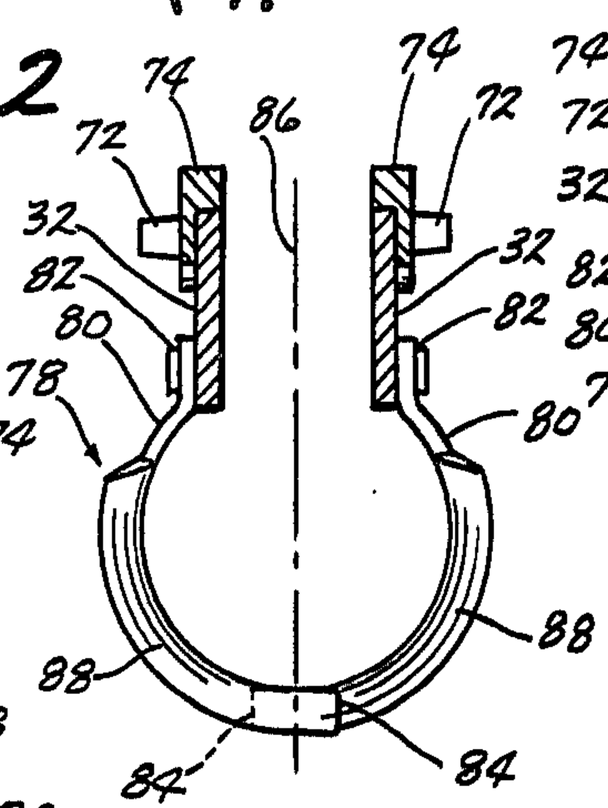

Fig. 4

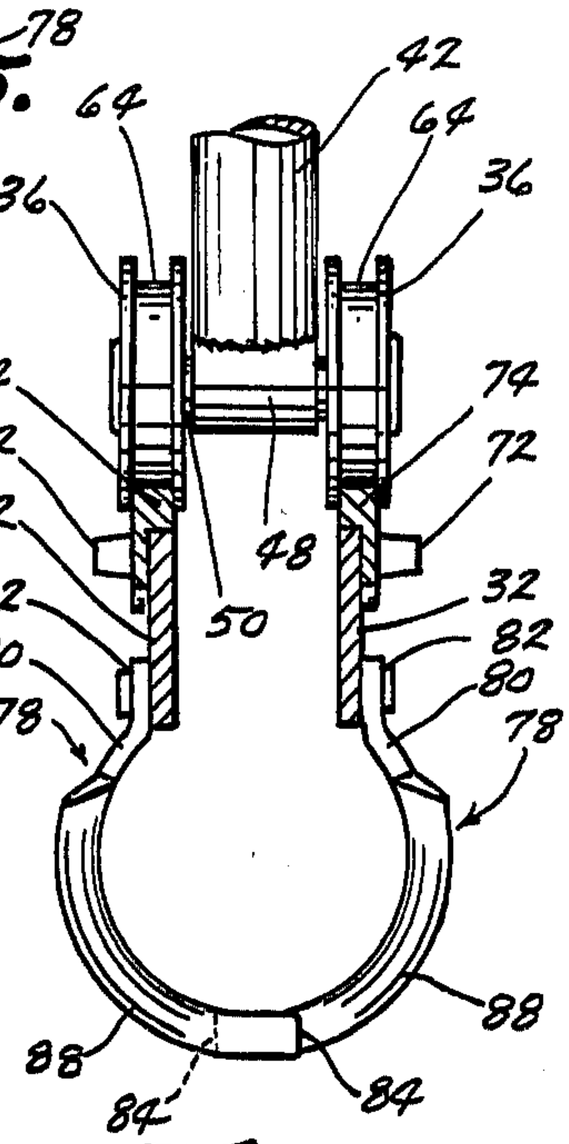

Fig. 5

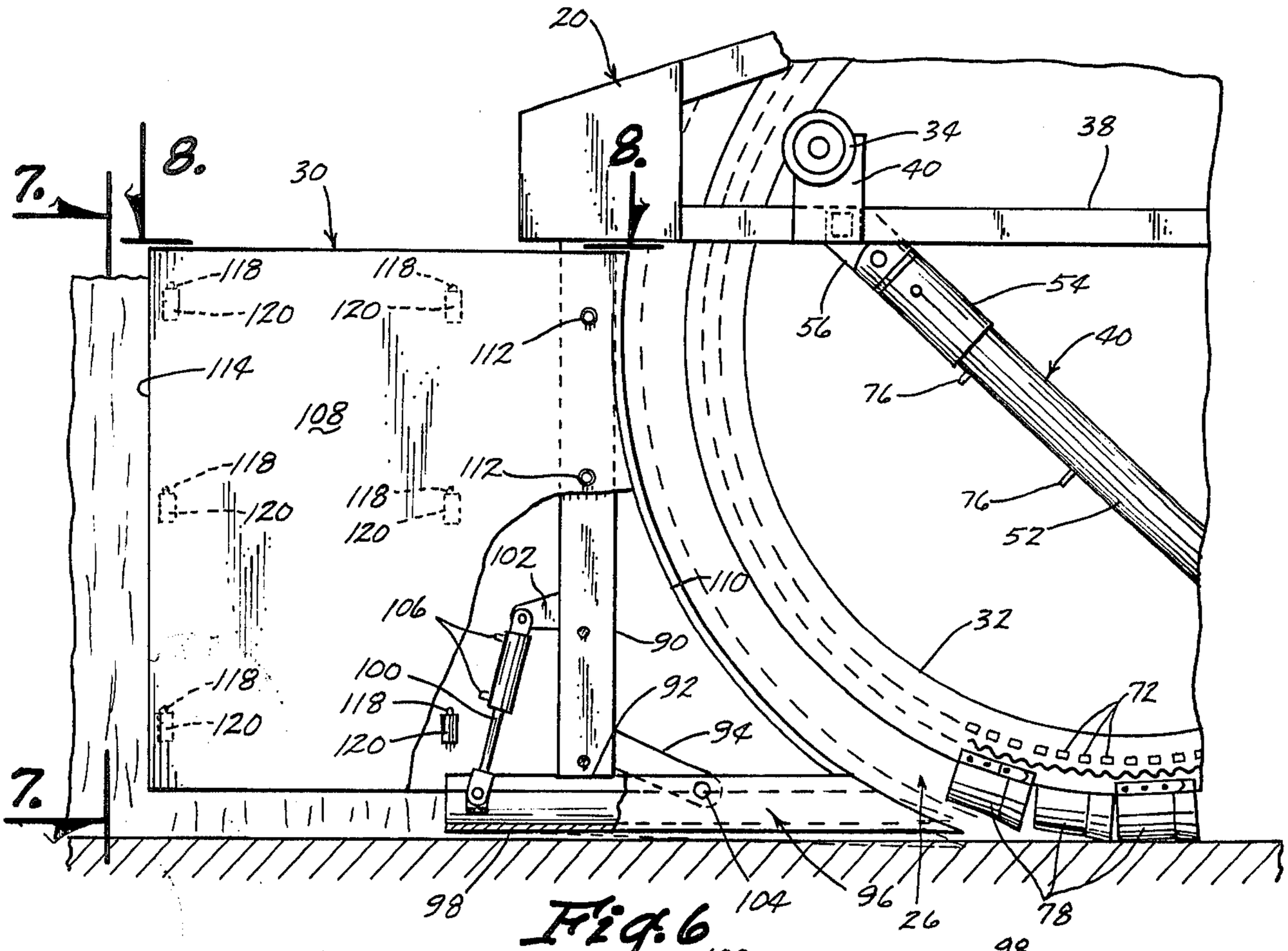

Fig. 6

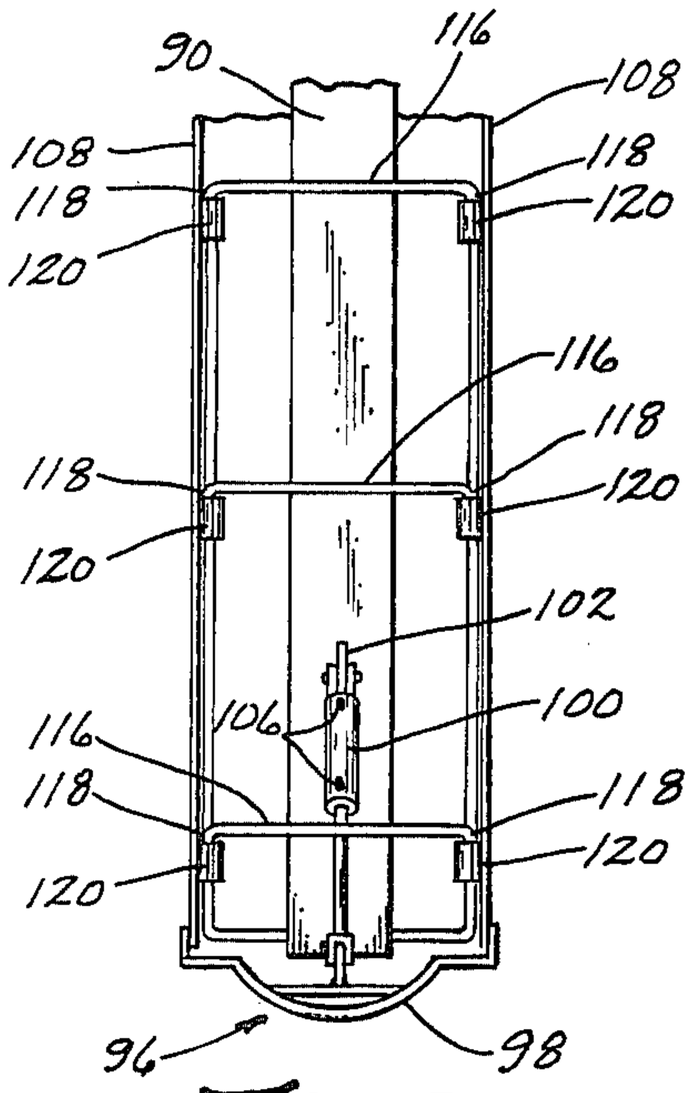

Fig. 7

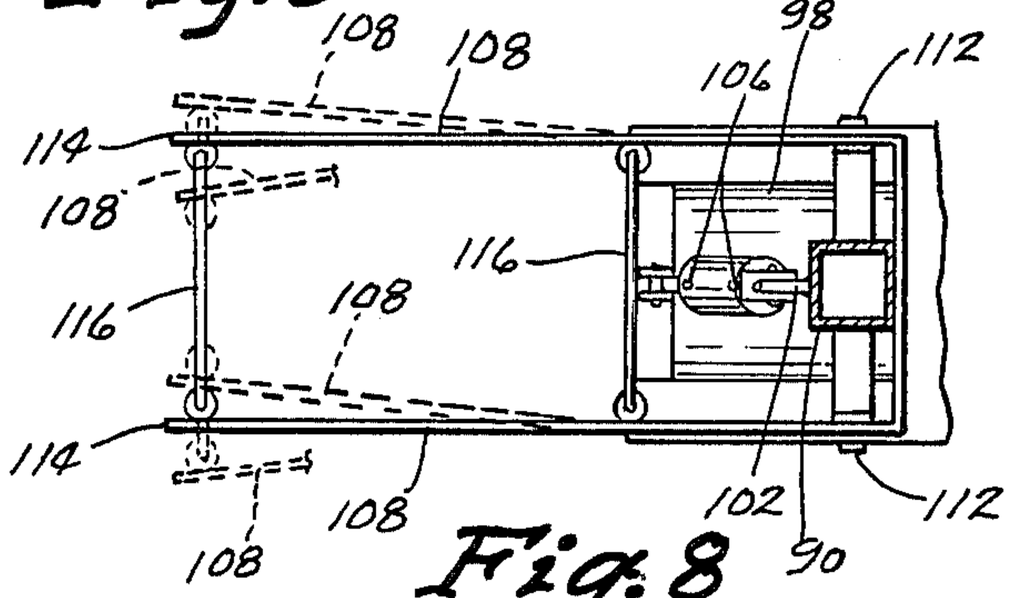

Fig. 8

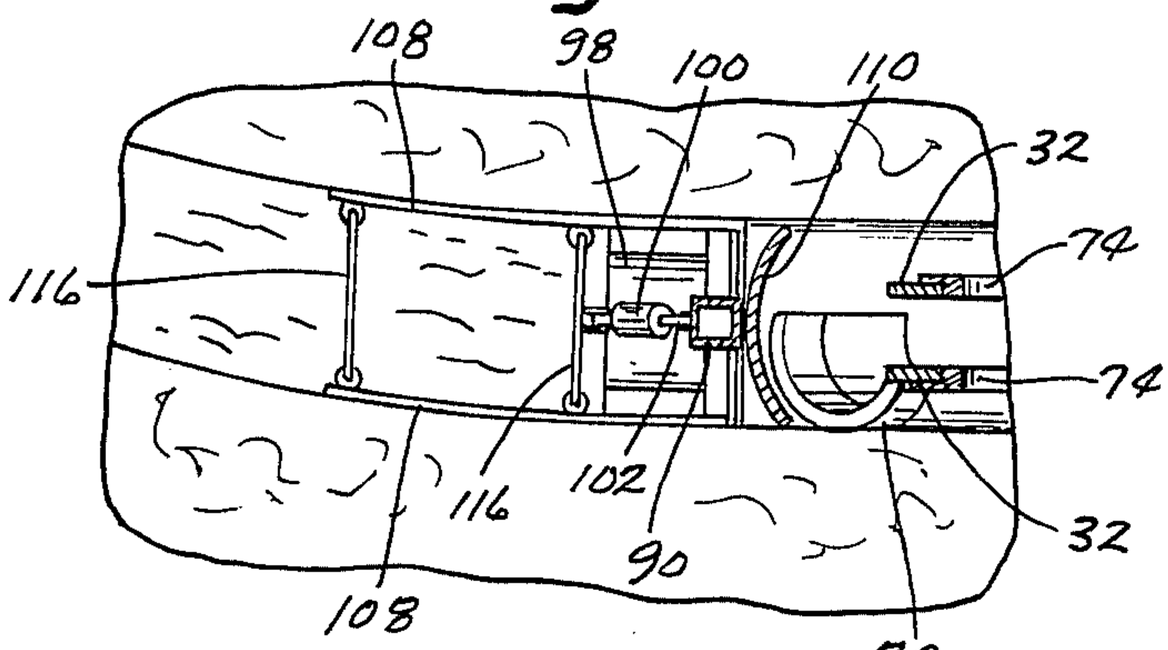

Fig. 9

SLACK TAKEUP APPARATUS FOR AN ENDLESS EXCAVATING MEMBER

BACKGROUND OF THE INVENTION

This invention relates to trenching machines of both the wheel or the chain type.

The drawings illustrate a trenching machine of the wheel type which includes a pair of spaced-apart circular rims mounted for rotational movement and including at their outer peripheral edges a plurality of excavating members for engaging the ground and excavating a trench. Certain problems have been encountered with trenching devices presently being used.

One problem pertains to the mounting of the circular rims for rotation. This is usually done by means of three wheels or dollies which rotatably engage the inner margins of the rims. Throughout extensive use of the trenching machine the inner margins of the rims begin to wear, and eventually there is substantial slack between the wheels and the rims. Taking up of this slack is a cumbersome task.

Another problem encountered with present devices pertains to the excavating members which are on the outer peripheral edge of the rims. These excavating members in presently known devices are of the same cross-sectional shape as the bottom of the trench to be excavated. Because each excavating member is the same shape as the bottom of the trench, there is considerable friction and resistance encountered during the excavating process. Furthermore, when the excavating member reaches the top of the circle, there is a scraping member which scrapes the material from the excavating member and permits it to fall to a conveyor to be carried away. With presently known excavating members considerable resistance is encountered between the scraping member and the excavating members, thereby causing wear and tear on the machine parts.

Another problem encountered with present excavating devices pertains to the shoe assembly which is mounted rearwardly of the excavating wheel. The shoe assemblies generally include two spaced apart parallel plates adapted to follow behind the wheel and to engage the lateral sides of the trench rearwardly of the wheel. These plates must be sufficiently rigid to provide reinforcement of the lateral walls of the trench immediately behind the wheel, but at the same time, they must be sufficiently flexible to permit the wheel to change directions as it is excavating the trench.

Another problem with the shoe assembly of the present devices pertains to the elongated shoe which is approximately horizontally disposed and which follows along on the bottom of the trench immediately behind the wheel. The horizontal attitude of this shoe must be adjusted slightly depending upon the particular soil configuration which is being excavated. Adjusting the attitude of this shoe has heretofore been a time-consuming and complicated problem.

SUMMARY OF THE INVENTION

The present invention provides solution to many of the above mentioned problems. One feature of the invention includes a movable dolly wheel which may be adjusted radially outwardly to take up the slack occurring between the dollies and the rotating rims as a result of rim wear. The movable dolly is mounted at the apex of two elongated members which in turn are pivotally mounted to the support structure of the machine. One

of these elongated members is telescopically longitudinally extendible so as to force the dolly wheel radially outwardly against the inner margins of the rims. A hydraulic cylinder actuates the telescopic movement of this member.

Another feature of the present invention includes the configuration of the excavating members. Each excavating member is shaped to excavate approximately half of the cross-sectional configuration of the trench. Half of the excavating members face in one direction and the other half of the excavating members face in the opposite direction. Because each excavating member cuts only half of the trench, the resistance encountered during the excavating action is substantially less. Furthermore, when each excavating member is scraped clean at the top of the wheel, there is substantially less resistance between the scraping blade and the excavating members. Furthermore, the soil has an unobstructed area through which to eject after having been scraped out of the bucket, and may then fall unobstructed to the conveyor belt or discharge chute.

Another feature of the invention includes the use of a shoe assembly having a pair of spaced apart plates mounted rigidly at the forward ends thereof to a vertical shoe post. The plates extend rearwardly from the shoe post and are inter-connected by a plurality of cross members pivotally mounted to each plate for pivotal movement about a vertical axis. The result of this configuration is that the plates are laterally flexible adjacent their rearward ends so as to permit the wheel to change directions as it is excavating the trench.

Another feature of the present invention relates to the use of a shoe mounted at the lower end of a vertical post in the shoe assembly. The shoe is mounted about a horizontal axis and includes hydraulic power means for adjusting the horizontal attitude of the shoe about the horizontal axis. The attitude of the shoe may be adjusted to accommodate soil of varying configuration merely by actuating the hydraulic cylinder.

Therefore a primary object of the present invention is the provision of a new and useful excavating device. A further object of the present invention is the provision of a trenching device which includes means for taking up the slack between the rotating wheels or dollies and the interior margins of the rims.

A further object of the present invention is the provision of a trenching device wherein the aforementioned slack between the wheels or dollies and the rotating rims may be quickly and easily taken up to overcome wear which occurs on the interior margins of the rims.

A further object of the present invention is the provision of a trenching machine having excavating blades which may be cleaned easily and substantially reduce the resistance encountered during excavating and cleaning.

A further object of the present invention is the provision of a trenching machine having a shoe assembly which is laterally flexible so as to permit the trenching machine to change directions as it is excavating the trench.

A further object of the present invention is the provision of a trenching machine having a laterally flexible shoe assembly which has sufficient resiliancy to return to its original position after being deflected laterally.

A further object of the present invention is the provision of a trenching machine which includes a horizontally disposed shoe which may be adjusted about a hori-

zontal axis to vary the horizontal disposition thereof so as to accommodate soils of varying configurations.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is an elevational view of the trenching machine of the present invention.

FIG. **2** is an enlarged partial view of the rotating rims, illustrating the take-up mechanism for taking up slack resulting from wear of the inner margins of the rims.

FIG. **3** is a partial perspective view of the rims and the wheel dollies which engage the rims.

FIGS. **4** and **5** are sectional views taken along lines **4** and **5** of FIG. **2**, respectively.

FIG. **6** is a partial elevational view of the shoe assembly of the present invention.

FIGS. **7** and **8** are sectional views taken along lines **7** and **8** of FIG. **6**.

FIG. **9** is a view similar to FIG. **8** illustrating the lateral flexing of the shoe assembly during excavation of a trench.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to FIG. **1**, the numeral **10** generally designates the trenching machine of the present invention. Trenching machine **10** includes a vehicle **12** supported by wheels **14**. Pivotally mounted about a horizontal axis adjacent the rearward end of vehicle **12** is a boom **16** which is adapted to be raised and lowered by means of a hydraulic cylinder **18**. Pivotally mounted to boom **16** is a frame assembly **20**. Frame assembly **20** pivots about axis **22**, and this pivotal movement is controlled by means of a second hydraulic cylinder **24**. Rotatably mounted to frame assembly **20** is a wheel assembly **26**. Also mounted to a frame assembly **20** are a horizontally disposed conveyor assembly **28** and a shoe assembly **30**.

Wheel assembly **26** comprises a pair of circular rims **32** which are rotatably mounted to frame assembly **20** by means of two stationary rotatable truck or dolly wheels **34**, and a third movable truck or dolly wheel **36**. Stationary dolly wheels **34** are mounted to a frame member **38** of frame assembly **20** by means of brackets **40**. Movable dolly wheel **36** is mounted to frame member **38** by means of a pair of truss members **40**, **42**.

Truss member **42** is pivotally mounted at one of its ends to a bracket **44** attached to frame member **38** for pivotal movement about axis **46**. The other end of truss member **42** is fixed to a collar **48** (FIG. **3**) which houses an axle **50** which in turn is mounted to movable wheel **36**. Wheels **36** and axle **50** rotate within collar **48**.

Attached to collar **48** and extending upwardly therefrom is the lower end **52** of truss member **40**. Lower end **52** of truss member **40** is telescopically received within an upper end **54** of truss member **40** so as to permit longitudinal telescopic movement with respect to upper and lower members **52**, **54**. Upper member **54** is pivotally mounted to frame member **38** by means of a bracket **56** for pivotal movement about axis **58**.

Mounted within upper and lower ends **54**, **52** of truss member **40** is an extensible hydraulic cylinder **60** having an extensible rod **62**. Rod **62** is attached to lower member **52** and cylinder **60** is attached at the opposite end thereof to upper member **54**. Thus, extension and retraction of cylinder **60** and rod **62** causes extension and retraction of upper and lower members **52**, **54** with respect to one another.

Referring to FIG. **3**, movable dollies **36** include an annular groove **64** adapted to retentively embrace the inner annular margins of rims **32**. Dollies **34** are of identical construction and also retentively engage the inner margins of rims **32**.

Rims **32** are rotated by means of a system of gears and chains **66**, **68**, **70** which ultimately drive a planetary gear (not shown) within frame assembly **20**, and this planetary gear is meshed with a plurality of cogs **72** protruding from rims **32**. Rotation of the gear system causes the planetary gear to rotate and because of its meshing relationship with cog **72**, rims **32** are rotated. As shown in FIG. **3**, the inner annular margins **74** of rims **32** are provided with a special hardened surface to minimize wear between the rolling engagement of dollies **34**, **36** and the inner margins of rims **32**. However, a certain amount of wear ultimately occurs, and this results in a loosening or slacking of the retentive engagement between the dollies and the rims. When this occurs, the operator actuates hydraulic cylinder **60** by connecting a hydraulic fluid system to valves **76**. Actuation of cylinder **60** causes extension of telescopic members **52**, **54** and forces movable dolly **36** outwardly, thereby increasing the pressure between dollies **34**, **36** and the inner margins of rim **32**. As wear occurs, this adjustment must be made periodically to insure that the cutter continues to excavate at the original set cutting depth.

While truss member **40** is shown to be telescopic and truss member **42** is shown to be of fixed length, these two members may be reversed so that truss member **42** is telescopic and truss member **40** is of fixed length. Furthermore, the present concept may be equally adapted to a chain drive system which utilizes only two dolly wheels. In such a system, the chain is trained around the two dolly wheels, and one of the wheels is movably mounted with respect to the other. The movable mounting is accomplished by means of truss members **40**, **42**, and extension of the extensible member **40** causes the movable dolly to move further away from the fixed dolly, thereby increasing the tension between the dollies and the chain.

Mounted on the exterior peripheral edges of annular rims **32** are a plurality of excavating members **78**. Each member **78** includes an arcuate plate **80** which has an upper flange **82** rigidly attached to the peripheral edge of rim **32**. Plate **80** in cross section includes a partial circular configuration which terminates at a lower end **84** (FIGS. **4** and **5**), located slightly over the center line **86** of the trench to be dug. Mounted on the leading edge of arcuate plate **80** is a tapered cutting edge **88** adapted to engage the earth and excavate the trench.

As can be seen in FIGS. **2–5**, half of the excavating members face in one direction and the other half of the excavating members face in the opposite direction with the lower tips **84** of the two sets of excavating members overlapping slightly. The excavating members of one rim **32** are circumferentially offset with respect to the excavating members of the other rim **32** as shown in FIGS. **2** and **3**, so that they each encounter the bottom of the trench at different sequential times. The advantage of this arrangement is that the excavating members encounter a lesser resistance at the bottom of the trench during the excavating operation due to the fact that they excavate only half of the trench cross-sectional configuration at a time whereas in previous devices, the excavating buckets cut the entire cross-sectional pattern of the trench and encountered substantially greater resistance during the cutting operation.

As the excavating members 78 progress to the top of the circle, they engage a scraping device (not shown) within the frame of frame assembly 20 which scrapes the contents of the excavating members and causes the contents to fall on conveyor assembly 28 and be carried laterally away from the trench. These scraping members are well known in the art, and consequently are not shown in the drawings. However, the fact that each excavating member includes only a half of the cross-sectional configuration of the trench, there is considerably less resistance to the scraping tools and the excavating members are cleaned more easily. Furthermore, the cleaning device forces the contents out of the excavating members with no resistance being placed directly opposite the excavating member. As the contents are ejected, they fall directly onto the conveying assembly 28.

Referring to FIGS. 6–9 a vertical shoe post 90 is rigidly secured at its upper end to the rearward end of frame assembly 20, and extends downwardly therefrom to a lower end 92 located slightly above the lower edge of the lastmost excavating member 78. Extending outwardly from the lower end 92 of shoe post 90 is a stub member 94. Pivotally mounted to stub member 94 for pivotal movement about a horizontal axis, is an elongated shoe member 96. Shoe member 96 includes a rounded bottom 98 (FIG. 7), adapted to slide along the bottom of the trench being excavated by the machine of the present invention. Pivotally secured to the rearward end of shoe 96, is an extensible hydraulic cylinder 100, and the opposite end of cylinder 100 is pivotally secured to an ear flange 102 extending from and attached to shoe post 90. Extension and retraction of hydraulic cylinder 100 causes shoe 96 to pivot about its horizontal axis 104 so as to change the horizontal disposition of shoe 96. Hydraulic cylinder 100 includes a pair of valves 106 which are easily accessible when the machine is in the ground and operating. This provides the operator with a convenient and time saving method of adjustment. The adjustment can be made while the machine is sitting or operating. The adjustment is needed as varying soil conditions are trenched, because varying soils have different scour characteristics. In normal operations, the leading edge of the shoe should be adjusted in the pitch-up attitude approximately three fourths of an inch above the rearward end thereof.

Also connected to vertical shoe post 90 are a pair of spaced apart shoe plates 108. Shoe plates 108 each include an arcuate forward edge 110 which is concentric to and spaced slightly outwardly from the outer peripheral edges of rims 32. Each plate 108 is bolted to vertical shoe post 90 by bolts 112, and extends rearwardly therefrom to rearward trailing edges 114. The spaced relationship between plates 108 is maintained by a plurality of cross members 116 each of which includes at its opposite ends a downwardly projecting hook portion 118 which is rotatably journaled for rotation about a vertical axis within the vertically disposed collar 120 mounted on the inwardly presented surfaces of plates 108. The effect of this configuration is that the rearward ends of plates 108 are laterally flexible, as illustrated in FIG. 8, but cross members 116 maintain the parallel relationship of the two plate members to one another.

In operation, as the trenching device commences digging the trench, plates 108 trail rearwardly therefrom and prevent a cave-in of the lateral walls of the trench. However, as shown in FIG. 9, as the trenching device turns to create a curved trench, the rearward end of plates 108 deflect laterally so as to permit the turning action. The rotational mounting of cross members 116 contribute substantially to the ability of these plate members to deflect laterally.

Thus, it can be seen that the device accomplishes at least all of its stated objectives. The extensible characteristics of truss member 40 permits dolly 36 to be moved radially outwardly to take up the wear and slack between the dollies and the inner margins of the rims. The excavating blades of the present invention may be cleaned easily, and minimize resistance during the cleaning action by virtue of the fact that there is no resistance at one side of the excavating member. The shoe assembly of the present invention permits adjustment of the shoe angle to accommodate soils of varying scour characteristics, and also the lateral deflectability of the shoe plates permits the excavating member to turn as it is excavating the trench. The device is simple in construction, economical to manufacture, and durable in use.

What is claimed is:

1. An excavating device comprising;

a support frame,

at least one generally rigid circular rim having a plurality of excavating members mounted thereon,

mounting means retentively movably mounting said circular rim to said frame for movement of said excavating members in a continuous circular path,

said mounting means comprising a maximum of three wheels including first and second wheels mounted to said frame for rotation about stationary axes and a third wheel movable relative to said first and second wheels, all three of said wheels being circumferentially spaced on said circular rim so as to engage said circular rim for rotatable retentive engagement therewith,

said first, second, and third wheels being comprised of substantially hard rigid material,

an elongated longitudinally extensible power member pivotally mounted at one of its ends to said frame and pivotally mounted at the other of its ends to said third wheel,

a second elongated member pivotally connected at one end to said frame and pivotally connected at the other end to said third wheel,

said third wheel movable radially outwardly of said circular rim in response to extension of said elongated power member, thereby to take up slack between said wheels and said circular rim.

2. A device according to claim 1 wherein said extensible member, said support frame and said second elongated member form a triangle.

3. A device according to claim 1 wherein said extensible power member and said second elongated member are connected to said frame at spaced-apart positions.

4. A device according to claim 3 wherein said one end of the extensible power member is pivotally connected to said frame adjacent said first wheel and said one end of the second elongated member is pivotally connected to the frame adjacent said second wheel.

5. A device according to claim 1 wherein said rim comprises an inwardly presented circular edge and said first, second and third wheels each have an annular groove retentively engaging said inwardly presented edge of said rim.

* * * * *